Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
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PHASE I TESTING OF	)	ET Docket No. 13-49
PROTOTYPE U-NII-4 DEVICES	)	
	)	
Report: TR 17-1006	)	

Comments of Cisco Systems, Inc.

Cisco Systems, Inc. (Cisco) wishes to commend the Office of Engineering and Technology's Laboratory Division for producing a thorough and thoughtful report about the laboratory testing of unlicensed devices that seek to share the 5.9 GHz band with Dedicated Short Range Communications (DSRC) devices.[1] The Public Notice reported that the underlying report demonstrated that "the that the prototype U-NII-4 devices were able to detect a co-channel DSRC signal and implement post detection steps as claimed by the submitters." This includes the prototype devices implementing Cisco's proposed detect and vacate method, in which Unlicensed National Information Infrastructure (U-NII or U-NII-4) would operate in the

[1] Office of Engineering and Technology Requests Comment on Phase I Testing of Prototype U-NII-4 Devices, ET Docket No. 13-49, Public Notice, DA 18-111, October 29, 2018.

band up to the point at which the devices detect the presence of a 10-MHz wide DSRC channel on 5855-5895 MHz, and then vacate the DSRC spectrum and the top portion of the adjacent U-NII-3 band.[2] Cisco is pleased that the Laboratory Division of OET has confirmed that the detect and vacate method performed as expected in the Phase I testing process. We look forward to learning more about plans for Phase II testing.

The Public Notice, in addition to publishing the test results for stakeholder review, requested comment on how various "developments" should impact the Commission's evaluation of the Phase I tests. Specific developments listed in the public notice are: (1) unspecified new technologies for autonomous vehicles (2) evolution of Wi-Fi standards (3) the development of cellular vehicle to everything (C-V2X) technology, and (4) the "limited deployment of DSRC in discrete circumstances." Additionally, the Commission asked how these developments should impact the plan for a three-phase test or the pending proceeding on unlicensed use of the 5 GHz band. Below, Cisco will address each of these topics in turn.

As an initial matter, Cisco would like to review aspects of the Phase 1 test where the nature of the test or the devices presented less-than-complete insights into the operation of the two proposed methods – (1) the detect and vacate method, and (2) re-channelization of DSRC coupled with application of Enhanced Distributed Channel Access (EDCA) to co-channel

[2] Cisco emphasizes that the proposed detect and vacate method applies to U-NII-4 operations only, and would not apply if devices are operating, for example, in U-NII-3 to the exclusion of U-NII-4.

transmissions on 5855-5895 MHz. Understanding where insight is limited is likely to be important as the Commissions prepares to enter into Phase II testing.

1. Re-channelization. Per the Report, "[t]he devices available for this test effort did not provide for DSRC operation on channels other than the basic safety message channel. Therefore, it was difficult to directly quantify the potential impact of U-NII-4 transmission to DSRC operations on channels other than the basic safety message channel."[3] The inability to review non-BSM channel impacts is of concern primarily for the re-channelization approach because U-NII-4 devices continue to operate co-channel with DSRC. It is far less relevant to the detect and vacate approach as a U-NII-4 device would remove itself from the band.

   More specifically, there is no direct evaluation of the re-channelization method's impact to co-channel operation for Vehicle to Pedestrian or other possible DSRC applications on non-BSM channels. This is concerning because in the deployments to date by state highway departments, virtually all of them are using non-BSM service channels for a variety of safety-related applications, including pedestrian safety (in various forms), speed warnings, wrong way entry warnings, transit signal priority, de-conflicting street car movements, and more. In fact, at this point in the process of DSRC deployment, there are an array of applications available for non-BSM service channels, with more being developed in real time.[4] At a minimum, re-channelization would need to be further evaluated for non-BSM service channel uses now deployed around the country.

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[3] Report at 16, 23.

[4] See generally the discussion of the three US DoT test pilots for examples of non-BSM uses of the 5.9 GHz band: https://www.its.dot.gov/pilots/. See also Nevada's use of DSRC to communicate between snowplows and roadside infrastructure to assist in managing snow removal and road treatment https://www.nevadadot.com/mobility/avcv. In Ohio, "the Ohio Turnpike has lit up a 60-mile test section of the toll road with a dedicated short wave radio communications (DSRC) connected vehicle technology pilot project This pilot project leverages edge computing to send real-time operational messages from thirty-eight Ohio Turnpike vehicles outfitted with DSRC technology and conversely send messages to a human machine interface (HMI) installed in the vehicle. The HMI messages sent to the vehicles provide real-time data updates on weather alerts, construction zones, incidents, and curve speed to a display device installed in the vehicle. The Ohio Turnpike hopes to achieve safety and efficiency benefits by deployment of this technology at the edge utilizing HPC." https://high-performance-computing.cioreview.com/cxoinsight/high-performance-computing-at-the-edge-and-in-the-cloud-nid-26718-cid-84.html

2. Re-channelization. While the tests revealed three distinct "regions" of DSRC packet completion rate performance when DSRC and U-NII-4 operate co-channel and simultaneously, the test report also reveals that staff could not directly isolate the interaction between a DSRC device and U-NII-4 device to understand why packet completion rates (PCR) varied as power levels of the devices varied. Testers were left to speculate why PCR varied in such distinct ways.[5]

   Observation of different "regions" of PCR performance is very useful, and can be used as baseline for Phase II testing. That said, since the mechanism that caused these distinctly different results is not well-understood, future changes in the MAC, clear channel assessment or CCA with enhanced detection might impact the observed PCR in unpredictable ways.

By contrast, there is nothing in the report that indicates that the Phase 1 tests or the testers were left with gaps in their understanding of how the detect and vacate method worked, at least within the bounds of the Phase 1 testing scope. This statement is not meant as a qualitative assessment of the two methods, but as an observation that detect and vacate presents a more straightforward path to testing than re-channelization. This difference needs to be kept in mind moving forward, as testers need to continue to consider what they do not know or what the tests will not reveal about the methods presented.

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[5] Report at page 96, noting PCR of DSRC decreases as the interference power level increases from -92 dBm to -82 dBm, then levels off as power level continues to increase from -82 dBm to -70 dBm, and then increases as the interference power level increases again from -70 dBm to -44 dBm. The report hypothesizes that the distinctly different levels of PCR may be due, as the PCR is initially falling, to IEEE 802.11 Medium Access Protocol prioritization and clear channel assessment operating in both types of devices, and once the PCR increase is observed, that the EDCA parameters are then favoring DSRC devices. There is no proffered explanation for why the PCR rate levels off.

As indicated above, the Commission sought stakeholder views on how it should evaluate the test results in light of four trends: (1) unspecified new technologies for autonomous vehicles (2) evolution of Wi-Fi standards (3) the development of cellular vehicle to everything (C-V2X) technology, and (4) the "limited deployment of DSRC in discrete circumstances."

Autonomous vehicles. This development is wholly orthogonal to the development of radio-based safety technology in the 5.9 GHz band. Autonomous vehicles are built to operate autonomously, without need of "remote control." On-board systems and navigation are intended to guide autonomous vehicles safety along roadways and to enable them to respond to the variety of events that inevitably occur along a public thoroughfare. Radio-based safety technology, therefore, is best thought of as an additional layer of safety technology that can contribute to safety, whether the vehicle is autonomous or conventional. Radio can assist because it can "see" through obstacles and around corners in ways that existing autonomous technologies cannot.

Evolution of Wi-Fi Standards. The development of Wi-Fi standards, and the evolution to wider channelization, has nothing to do with detection capabilities that are needed for a sharing mechanism. While the detector prototype Cisco provided was based on IEEE 802.11n technology, that version of device was selected for the ease in which the device could be converted into a 4-channel, 10 MHz-wide detector needed for Phase 1 testing. Detectors can be built for whatever licensed emissions need protection. This has nothing to do with U-NII-4

Radio Local Area Network (RLAN) operations, which can take advantage of wider channels from IEEE 802.11ac or 802.11ax.

In addition to developments impacting wider channels for RLAN operations, the IEEE is currently evaluating member interest in tackling an evolution of the IEEE 802.11p standard that is the basis for existing DSRC. A "Next Generation Vehicle" Study Group has produced for review a Project Authorization Request (PAR) that, if approved as expected, will lead to the formation of a Task Group when IEEE 802 meets early next year.[6] As the standards evolution process is still very early in cycle, as a practical matter the Commission should not take into account potential changes to IEEE 802.11p, but continue to monitor the IEEE 802.11 process.

C-V2X development. As discussed above, C-V2X is early days. Not only does the technology need to be tested by government agencies and automobile manufacturers to ensure it can perform at least as well as DSRC under all reasonable conditions, there are a number of significant questions that remain entirely open about whether C-V2X can support an ecosystem that will contribute to road safety in the same way that DSRC has been designed to do. For example, there is no public information based on business models – is C-V2X supposed to be built by public authorities or by mobile operators? Where will applications come from and how will they be defined? Who will decide what data is available and on what terms and conditions? In the DSRC context, these questions all have answers and there is activity on every level – from car manufacturers, state highway departments, the federal transportation

[6] https://mentor.ieee.org/802.11/dcn/18/11-18-0861-09-0ngv-ieee-802-11-ngv-sg-proposed-par.docx

regulators, vendors of hardware and software, reference architectures to enable integration into state-owned IP networks, etc. In the context of C-V2X, however, these are not questions that the FCC is well equipped to answer with jurisdictional constraints limited to radio technology. But the answers have enormous consequence for the federal and state agencies who have jurisdictional responsibility for road safety. Stated differently, C-V2X should not be evaluated as a simple technology choice. It must be evaluated in the larger context of whether it can deliver on the promise of safer highways.

From a sharing perspective, if Cisco were to build a detector to detect C-V2X transmissions, then we see no barrier to proposing a detect and vacate sharing mechanism for C-V2X, assuming C-V2X is intended to occupy all or most of the band below 5895 MHz. The physics of the band do not change with technology. C-V2X needs to be deployed in an architecture quite similar to DSRC, and that means significant spectrum would be lying fallow much of the time because, away from roads or where roads are mostly empty, there are no C-V2X on-board units or road-side units operating in the vicinity of Wi-Fi. Naturally, the Cisco prototype provided for the Phase 1 test does not address C-V2X as that technology, unlike DSRC, is not commercially available. If C-V2X units were commercially available, Cisco sees no technical bar to developing a detect and vacate proposal. That said, the sharing mechanism with C-V2X could be more complicated, and could place heavier burdens on power consumption, than the detect and vacate proposal for DSRC. This is a function of DSRC being part of the IEEE 802.11 family of technologies, with a preamble readily-identifiable by the U-NII device.

Two additional complications exist for C-V2X. First, given that the technology is early days, and appears to be subject to the mobile ecosystems' desire to move from a 4G to a 5G environment, building a C-V2X detector raises some very practical questions for which there are presently no known answers. For example, it is unclear if a detector would be built for 3GPP Release 14, Release 16, 5G New Radio, or some other part of the 3GPP family of standards. Some technological clarity needs to be injected into the debate. Second, Cisco has not yet evaluated how these various signals could impact our ability to process more than one sample transmission before the U-NII sharing device would vacate. Although we lack at present an understanding of the signal to be protected, we believe it could be possible that the U-NII sharing device may need to listen longer before vacating, and may need to stay away longer.

Limited deployment. The notion that deployments are "limited" and the follow-on implication that now is an easy time to change 5.9 GHz radio safety technologies, is false. Deployments will always be limited – no matter what the technology. The physics of the band dictate the network topology – road side units will need to be deployed densely along roadways, and therefore money should be spent, and networks deployed, where the roadside networks can do the most good. Roads that carry a lot of traffic, where there tend to be more accidents, or that have a history of safety issues are likely to be the places where radio-based safety technology can have its largest impact. The economics of deploying roadside radio networks to every cul-de-sac would not, at first glance, make sense no matter what the technology.

In addition, the knowledge of where to deploy to get the most benefit is not in the hands of the cellular industry or its vendors, but in the hands of state highway departments, who are best positioned to understand how the various applications of radio safety (from BSM to a variety of transportation applications) can assist in reducing traffic accidents. Deployments do not have to be ubiquitous to provide important benefits. The DSRC market puts the question of deployment of roadside units squarely in the hands of those with the best information – state highway departments.

Moreover, the DSRC market is developing rapidly, and Cisco is fully participating in it with our Connected Roadways solution and reference architectures.[7] From our marketplace interactions, Cisco sees that state transportation officials are increasingly interested in deploying radio-based solutions, and funding is happening for many deployments outside of the three sites that US DoT has established to further develop applications for V2X technology. "Limited deployments" is not a reason to abandon the DSRC sharing test approach.

[7] https://www.cisco.com/c/en/us/solutions/industries/transportation/connected-roadways.html While not every Connected Roadways implementation includes a DSRC component, interest in DSRC is increasing.

In conclusion, Cisco commends the Laboratory Division of the Office of Engineering on the Phase I test report. Cisco looks forward to learning more about Phase II.

Respectfully submitted,

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